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ABSTRACT

Designed for students in grades seven through twelve, this elective, quinmester guide offers an outline on techniques in enameling. Objectives are for students to research, demonstrate, experiment in, and evaluate the art of enameling by tracing the historical development of the art, applying elements of design, demonstrating techniques and procedures and evaluating their own work in class discussion. The course outline contains a course description, rationale, guidelines, objectives, course content, strategies and procedures for design, firing, preparing metals, soldering, suggestions for the instructor, and resources for students and teachers. Related documents are SO 005 207, SO 005 269, and SO 005 271. (SJM)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DADE COUNTY PUBLIC SCHOOLS

Visual Arts Education

CREATIVE ENAMELING ART

6681.22

DIVISION OF INSTRUCTION • 1971

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CREATIVE ENAMELING ART

(Tentative Course Outline)

6681.22

6682.22

6683.25

ART EDUCATION

Written by: Anne C. Hilf

for the

DIVISION OF INSTRUCTION
Dade County Public Schools
Miami, Florida
1971

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I. COURSE TITLE

CREATIVE ENAMELING ART

II. COURSE NUMBERS

6681.22

6682.22

6683.25

III. COURSE DESCRIPTION

Techniques in enameling are taught to facilitate the student's personal expression through the medium of creative art enameling.

IV. RATIONALE

The function of enamel is to add color and decoration to the metal on which it is fused. Its hard surface adds utility. It enhances and protects the metal surface on which it is fused. Enameling is functional as an art form with strong influences in the commercial world.

V. COURSE ENROLLMENT GUIDELINES

A. Grades 7-12

B. No prerequisite for this course

VI. COURSE OF STUDY OBJECTIVES

A. Competencies expected of the student. The student will be able to do the following:

1. Research the historical applications of enamels and relate the research to contemporary products.
2. Apply the elements of design to the planning and production of enameled objects.
3. Demonstrate his understanding of enameling techniques and procedures.
4. Design and produce at least five enamelings.
5. Perform the assigned task in enameling according to the directions and specifications of the tools and materials used in the operation of the task.
6. Critically evaluate his work by displaying it for a class antique, discussing the results with the instructor, and fellow students.

B. The conditions under which the student will be expected to demonstrate his competence:

1. Research
2. Demonstration
3. Studio work
4. Experimentation
5. Evaluation and critique

C. Standards for acceptable performance. The student will meet or surpass standards established by the instructor on behavioral objectives 1 through 6.

VII. COURSE CONTENT

A. Definition and background

1. Historical Survey

a. Egyptians and Assyrians - Used clay and brick surfaces. The palace of Rameses III at Tell el-Yehudia and the palace of Nimrod in Babylon contained large walls of tiles decorated with enamels.

b. Greeks and Romans - Produced enameled jewelry with fine detail. Greek sculptors often enameled the eyes of their sculptures.

c. Byzantines - Cloisonne enameling perfected. In every church in Constantinople there were chalices, patens, cases for sacred relics and bindings for gospel and service books made from combinations of metal, enamels, and precious stones. Byzantine craftsmen used combinations of simple colors, motifs, and values to create patterned pieces exceptionally strong in design quality.

d. Chinese and Japanese - Cloisonne in design detail outlined by metal bands so that it completely covers the whole surface to be decorated.

e. French - Mosan School influenced symmetric designs in enameling -- vertical and horizontal placement of the enameled areas - use of champleve, cloisonne

lemoge.

f. Italian - development of Basse-taille technique -- during the fourteenth century.

g. Contemporary - Employs all traditional techniques -- enamels include jewelry, bowls, trays, boxes, spoons, other utensils and plaques. Commercial enameling techniques have permitted the use of enamels on pans, stoves, spoons and utensils, cup and other familiar items.

B. Basic Enameling Procedures

1. Enamels

a. Proportions of flint, lead oxide, soda and potassium hydroxide from the frit or enamel flux -- a clear, colorless glass form.

b. With different proportions of lead and potassium hydroxide, this frit may fuse at higher or lower temperatures.

c. Metallic oxides are added to the frit to produce the many colors available.

d. The addition of tin oxide makes the colored enamel opaque or translucent.

e. Opaque colors fuse at a higher temperature than do the transparents.

f. Enamels should be washed before using -- rinse until water is clear.

2. Metals

   a. Fine silver, copper or enameling gold.

   b. Sterling silver, though much more durable than fine silver, tends to discolor transparent enamels, and when soldering is necessary, the high-melting solders necessary to enameling cannot be used.

   c. Copper is the easiest and least expensive metal to enamel.

   d. All metals must be annealed and completely free of oxides and dirt.

   e. If the object is pickled after annealing and kept under water until ready for use, it remains quite clean.

3. Application

   a. Dry method

      (1) Dusting or sprinkling powdered enamel directly on the clean surface.

      (2) Painting or spraying an undercoat of gum arabic solution on the surface to ensure adhesion.

      (3) Enamel powders are dusted through an 80-mesh screen which is folded into a box-like container.

      (4) Firing two thin coats of enamel separately is preferable to one thick coat.

b. Paste Method

(1) Adding gum arabic to powdered enamel to form a paste.

(2) Inlaying or spreading over the metal surface with a small, polished spatula.

(3) Moistening the metal surface with a diluted gum and water solution.

c. Counter-enamel

(1) Applying a layer of enamel to the back of the object for every layer on the front, usually on metals of 18 gauge or thinner.

(2) Counter-enameling to prevent warpage of the cooling metal after firing.

(3) Using a steel stilt or trivet to hold the piece during firing.

4. Firing

a. Fusing the ground glass in an electric kiln or with a torch.

b. Making use of the kiln to assure a more evenly distributed heat; a pyrometer assists in regulating the heat.

c. Using a torch for small pieces where complete observation of the firing process is desired.

d. Effecting a pulsing heat, caused by a rhythmic touch and withdrawal of the flame, seems to fuse

The enamel easily without too much danger of overheating the metal.

e. Gently preheating the piece at the mouth of the kiln before setting the prepared work in the kiln for the full firing.

Note: If too much moisture remains, steam causes the enamel to lift away from the metal and to scatter particles.

5. Finishing

a. Stoning the edges to remove fire scale.

b. Using a carborundum stone under water to gently clean the edges.

6. Soldering

a. Soldering on findings with hard or high-melting silver solder if they are to be soldered on before the first enamel firing.

b. Findings attached after firing must be applied with soft solder (lead base).

c. Keeping a small patch of metal bare where the findings are to be set when counter-enamel has been used.

C. Enameling Processes

1. Limoges or painted enamel

a. Enamels completely cover the metal surface with no dividers.

b. The cleaned metal is covered with a surface of

enamel flux or an opaque color.

c. Other colors are added, either moist or sifted on.

d. Each layer is fired separately but may consist of as many colors as desired.

2. Sgraffito

a. Enamel basecoat as in Limoge

b. After firing, cooling, and stoning the edges, sprinkle with a second coat over a gum coating.

c. Scratch the design through to the base coat with any pointed tool.

d. An alternate method is to mix enamel with gum tragacanth to paste and apply with a spatula, place the piece on top of the kiln until the paste is dry, and then scratch the design.

3. Grisalle or Chiaroscuro

a. Metal is covered with a fused layer of opaque black or a very dark transparent blue.

b. Opaque white enamel is made into a paste and applied in a fairly thin layer where the design is to be formed.

c. As they are fired the white particles sink into the dark background and become gray.

d. Subsequent layers of white over all or part of the original area become more and more opaque.

4. Painting with oil or glycerine

   a. Prepare metal, apply and fire a base coat.

   b. Paint the design with a small brush using light machine oil or glycerine.

   c. Dust evenly with powder.

   d. Tap off excess powder -- enamel as it will adhere only to oil or glycerine design.

5. Stencil

   a. Fuse base coat.

   b. Cut a stencil from paper and moisten with a damp sponge.

   c. Lay in place on enameled piece and dust with powdered enamel.

   d. Lift off stencil with tweezers so the design remains undisturbed.

   e. After firing, other stencils can be used to create a more complex design.

6. Glass beads, fragments or threads

   a. Prepare metal, apply and fire a base coat.

   b. Place threads, beads or chunks in a pattern and fire until they melt in place.

7. Overglaze painting

   a. Prepare a design.

   b. Prepare copper, apply and fire base coat -- use a light color to permit the design to show clearly.

c. Transfer design to enameled piece using a china marking pencil or carbon paper. Scratch the design into the base coat with a steel point and remove the carbon or grease pencil lines with carbon tetrachloride.

d. Paint the design with overglaze enamels.

e. To vary the color, glazing colors over one another is preferable to mixing them together.

f. If pan colors are used, they must be fired at a lower temperature.

g. A final coat of clear flux may be dusted over the surface and fired to prevent peeling and oxidation

8. Cloisonne

a. A design based on areas that can easily be enclosed with wire separators.

Note: Cloisons serve as walls that prevent color areas from running together.

b. Plan the design.

c. Bend the wire into desired shapes. Use pliers or a nail for bending the wire.

d. Flatten the bent wire design with a mallet on a hard surface.

e. Lay in place on the cleaned piece of copper.

f. Flatten against the back piece so they fit closely together.

g. Place on a sheet of paper and dust with flux.

h. Fire. After firing push any raised wire against the back instantly while the piece is still hot.

i. Mix enamel powder with water to a paste.

j. Fill the cloisons with enamel paste.

k. Tamp color into place and remove any smears on the wire.

l. Fire. Refill and refire until the Cloisons are filled to the top.

m. Clean the surface of the wire and edges with the carborundum stone under running water.

n. Cloisons may be placed on the piece separately, rather than in one piece. The separate shapes must be placed to create closed areas that can be filled with enamel paste.

9. Champleve - inlaid enamel

10. Plique-A-Four - windowed enamel

11. Cloisonne - silver wire

12. Basse-Taille - sculptured enamel

13. Niello

D. Tools, equipment and materials

1. Rubber mallet

2. Loading fork

3. Round-nosed pliers

4. Bench pin and vise

5. Jeweler's saws
6. Hand drill
7. Hole punch
8. Bench vise
9. Tweezers
10. Kiln
11. Propane torch
12. Cutting pliers
13. Enamel tools and spatulas
14. 80 mesh screens
15. Powered enamel - opaque and transparent
16. Glass beads, threads, and chunks
17. Nichrome fire screens
18. Copper - blanks and pieces
19. Silver - fine silver small jewelry pieces
20. Copperwire (20 gauge or smaller)
21. Soft solder and flux
22. Carborundum stone
23. Steel wool
24. Light machine oil or glycerine
25. Jars for leftover enamels
26. Spatula
27. Sheet mica
28. Scissors
29. Hand file

30. Asphaltum and brush

31. Jewelry findings

32. Sparex pickling acid

33. Scale coat or salt water

34. Asbestos sheet

35. Firing stilts or trivets

36. Gum tragacanth or gum arabic

37. Kilnwash

E. Design Pieces

1. Jewelry

a. Pins

b. Earrings

c. Pendants

d. Cuff links

e. Tie tacks

f. Bracelets

g. Rings

2. Bowls

3. Dishes

4. Trays

5. Utensils

6. Plaques

7. Decorative panels

8. Candle holders

9. Ash trays

10. Metal sculpture

11. Belt buckle

12. Combination with other materials

a. Leather

b. Other metals

c. Wood

d. Plastic

VIII. STRATEGIES AND PROCEDURES

A. Design

1. Object

a. Precut copper blanks

b. Original designs

(1) Jewelry

(a) Copper sheets and jewelers saw

(b) Organic forms research for design shape

(c) Geometric forms

(d) Animal, insect, bird stylized shapes

(e) Abstract non-objective forms

(2) Plaques - decorative

(3) Candle holders - research forms and function

(4) Metal sculpture

(a) Organic forms

(b) Geometric forms

(c) Abstract - non-objective forms

(d) Copper sheets

(e) Mallets

(f) Bench vise

2. Decoration

a. Use of design elements and principles

(1) Color

(2) Shape

(3) Texture

(4) Balance

(5) Unity

(6) Rhythm

(7) Line

b. Research and creative design

(1) Abstract

(2) Non-objective

(3) Natural forms

(4) Geometric forms

B. Firing

1. Kiln

a. Preheat kiln to 1500 degrees F. The temperature drops about 150 degrees each time the door is opened and if the kiln is preheated about 45 minutes before use, lost heat is more easily regained.

b. Wear an asbestos glove when loading and unloading the kiln.

c. Load kiln and close door quickly - leave piece inside for about 1-1/2 minutes.

d. Remove when surface is smooth and shiny - place the fire screen with its load on an asbestos sheet to cool.

e. Fire paired pieces together since it is difficult to duplicate a firing.

2. Enameling stages

a. Piece becomes quite dark - though still retaining its particle shape.

b. The particles fuse and the total mass sinks as the enamel becomes fluid. The surface is still uneven. The enamel and the metal may now glow with the same color.

c. The enamel, now thoroughly fired, will spread to its confined areas. The surface will be quite smooth and flat and highly reflective.

d. Remove the work from the kiln and examine. If small gas bubbles have formed near the surface they may be pricked with a needle and the enameling refired.

e. Cool evenly and slowly. Cracks develop when the relatively inert cooling enamel cannot keep up

with the more rapid contraction of the cooling metal.

C. Preparing metals

1. Cleaning copper

Note: Surface impurities may prevent the enamel from adhering to the metal.

a. Clean the copper with steel wool, emery cloth, a file, or dip it in a 5 percent nitric acid solution, or sparex metal cleaning powder.

b. To clean with steel wool hold piece by the edges and brush the surface with a rotary motion.

c. Once the copper is clean it is important to keep fingers off the surface.

2. Protection from fire scale

a. Fire scale occurs when copper is heated.

b. Protect unenameled areas with a thin coat of salt water (one tablespoon to a cup of water).

c. Commercial preparations are available.

D. Soldering

1. Use soft solder, since it flows at temperatures below the fusing point of enamel.

2. Apply soft solder flux to all areas to be soldered. (Flux in paste form is most convenient.)

3. Some soft solders, such as rosin, core or acid core, contain their own flux.

IX. SUGGESTIONS FOR THE INSTRUCTOR

A. For further information: Refer to following quinmester courses for reference.

1. Where It Starts - (basic design)
2. Contemporary Design
3. Jewelry Design I - (cutting and forming)
4. Metallic Formations I - (soldering)

B. Copper

1. Use precut blanks for beginning projects.
2. Copper printing plates can be used for enameling.
   a. Usually on wood backing
   b. Remove from wood by placing in kiln until glue is burned away.
   c. Clean copper plates and polish with steel wool.
3. Use 18 gauge on thicker copper.
4. Stress cleanliness of copper.

C. Unsuccessful firings

1. Enamel pulling away from edges -- oil fingers over edge -- enamels will not adhere
2. Black specks in enamel -- steel wool particles not rinsed off

3. Enamel pops off surface during cooling -- fire scale not cleaned off after last firing or counter -- enamel needed to maintain proper tension
4. Enamel cracks during cooling -- cooling too rapidly
5. Enamel steams and flies off metal during firing -- enamel not dry when placed in kiln
6. Enamel crawls away from edge -- too light a covering of enamel
7. Enamel runs and puddles in center of concave surface -- piece fired too long or too high
8. Surface bumpy and uneven -- not fired long enough or high enough

X. RESOURCES FOR STUDENTS AND TEACHERS

Books

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Moseley, Johnson, Koenig, Crafts Design, Belmont California: Wadsworth Publishing Company, 1962.

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